PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Joint Constructions

We, UNITED AIRCRAFT PRODUCTS INC., a Corporation organised under the State of Ohio, United States of America, of Dayton, Ohio, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to joint constructions, and particularly to a sealing arrangement in such joints providing an effective seal under conditions of extreme temperatures and pressure.

An object of the invention is to present a means to compensate for relaxation of the structure members of a coupling, including the threads, as might be caused by sudden and large changes in temperature and pressure conditions.

According to the present invention a joint construction includes a pair of joint members brought to an assembled position by a relative axial approaching motion, one of said members being received within the other, means on said members defining an O-ring groove, a compressible O-ring in said groove, and means obtaining in response to a relative axial approaching motion of said members to assembled position first a radial compression of said O-ring and then a longitudinal compression thereof.

Embodiments of the invention are illustrated in the accompanying drawings in which:—

Figure 1 is a fragmentary view in cross-section of a pipe joint or coupling in accordance with the illustrated embodiment of the invention;

Figure 2 is a detail view, enlarged with respect to Figure 1, of a portion of an installed sealing ring;

Figure 3 is a detail view of a fragment of a sealing ring showing the configuration thereof prior. to installation in the coupling;

Figure 4 is a detail view in cross-section of another embodiment of the invention, showing the obtaining of a radially acting seal in a clamped joint, and

Figure 5 is a view similar to Figure 4 showing a coupling or closure characterised by a bolted joint.

Referring to Figure 1 of the drawing, a joint construction in accordance with this illustrated embodiment of the invention serves to interconnect the end of a tube or pipe 10 with the adjoining end of another tube or pipe. The joint comprises a first or outer body member 11 and a second or inner body member 12. The body 12 has a stem or shank portion 13 which is received within one end of the outer body member 11 and which terminates in a conical end portion 14. The pipe end 10 is received in the opposite end of the body member 11 and terminates in a flared portion 15 adapted to seat on the conical surface 14 in a manner to define a sealed joint. The stem or portion 13 of the body member 12 has a through bore 16 registering with and communicating with the pipe 10 whereby to conduct fluid to the other adjoining end of the other pipe, it being understood in this connection that the body member 12 is symmetrical with a second stem or projection 13 in opposed relation to the one illustrated, and there further being a second outer body member thereon like the body 11.

Rearwardly or outwardly of the conical surface 14 on the stem portion 13 the exterior of the stem is formed with an inclined surface 17. This in turn terminates in a cylindrical portion 18 while the latter ends in a radial wall or shoulder 19. Beyond the shoulder 19, the stem 13 is externally threaded to mate with internal threads on the outer

body member 11. Within the body member 11, inwardly or to the left, as shown in Fig. 1, of the internal threads thereof, the surface of the body member 11 is formed with a taper formation 21 terminating in a cylindrical portion 22 of a size to receive the shoulder 19 of body member 12. The portion 22 terminates in an internal ledge or shoulder 23 while the body is again counter-bored to provide a further step-down portion resulting in an internal shoulder 25. Interconnecting the shoulders 23 and 24 is a taper formation 25 and a cylindrical formation 26. An opening 27 in the body element 11 admits the tube end 10.

Also contained in the body element 11, and in surrounding relation to the adjacent ends of the tube end 10 and the stem 13, is a floating member 28. It is comprised of a cylindrical portion 29 aligned in the cylindrical portion 22 of the outer body element, with one end thereof seating against the internal shoulder 23. Another cylindrical portion 31 of the member 28 is offset from the portion 29 and extends into the cylindrical portion 26 of the body member.

A resilient ring seal 32 is mounted in the annular groove defined by the shoulder 24, cylindrical portion 26 and the adjacent end 31 of the floating member 28. A similar ring seal 33 is contained in an annular groove defined by the cylindrical portion 18 on the stem 13, the shoulder 19 thereon and the adjacent end 29 of the floating member 28. Ring 32 makes a sealing contact between the surface 26 of body element 11 and the external surface of tube 10. Ring seal 33 makes a similar contact between cylindrical surface 18 and the surface 22 of the outer body member. In the one case an escape of fluid out of the coupling by way of opening 27 is inhibited and in the other case escape by way of the threads interconnecting the two body elements 11 and 12 is inhibited. The sealing rings engage their respective surfaces with an inherent resilience, which, according to a feature of the invention is predetermined as to degree and automatically arrived at in the assembly of the coupling. Thus, in pressing the ring 32 into place to a seat on the shoulder 24, it is constrained by the taper formation 25 to be laterally compressed. Initially, the sealing ring is round as indicated in Figure 3 but when compressed by installation in the body member it assumes a generally oval configuration as indicated. The sealing ring, in this instance a hollow metallic O-ring, tends to resist such compression and so tends to maintain a tight seal with the radially engaged surfaces. The ring may be internally pressurised for greater sealing effect, or be self-energised for a balancing out of pressures under control as described in Specification No. 752,760. The taper 25, the sealing ring dimensions and the size of cylindrical surface 26 all are proportioned, it will be understood, to obtain a predetermined degree of compression of the sealing ring and to obtain such compression automatically as a function of the assembly of the parts. The sealing ring 33 is similarly given an initial compression by assembly of the parts and through the co-operation of tapers 17 and 21.

Further in the assembly of the parts, it will be seen that as the stem 13 is advanced into the outer body member 11, the end 29 of the floating member 28 is engaged and the floating member is urged toward a seat on the shoulder 23. At about the same time this shoulder is engaged, however, the end 13 of the floating member engages the ring seal 32. Continued advance of the stem 13 accordingly results in a longitudinal compression of the sealing rings 32 and 33 as the floating member is brought to a seat on shoulder 23. Compressed both laterally and longitudinally, the sealing ring assumes substantially the shape shown in Figure 2. In attempting to recover from this compression, in a longitudinal sense, the sealing ring 32 applies a longitudinal thrust to the floating member 28 outwardly or toward the stem 13. Intermediate its ends the floating member 28 is formed with an inclined surface 34 conforming in shape to the flared end 15 of the tube 10 and adapted to engage such flared portion. The thrust applied to the floating member by ring seal 32, therefore, is transmitted to the flared end of the tube in a manner to press it against the conical end 14 of the stem 13. A continuous, resilient pressure thus is applied toward the maintaining of the original seal at the flare 15. Temperature variations, as might result for example from severe quenching conditions within the coupling, and which tend to produce a relaxation of the structutre members of the coupling, including the threads, are compensated for and the seal is maintained.

Referring to Figure 4, in this illustrated embodiment of the invention, interengaged components or conduit fittings 35 and 36 have respective mating flanges 37 and 38, and an external clamp 39 holds the flanges in abutting contacting relation. The interengaged end of member 35 is counter-bored to define, in longitudinally spaced relation to the bottom plane of flange 37, as viewed in Fig. 4, a cylindrical surface 41 terminating at its one end in a transverse shoulder 42. From the other end of surface 41 a flared or outwardly tapering surface 43 extends to the bottom plane of flange 37. The member 36 has a nose like central projection 44 adapted to be received within the member 35. An external forming of such projection provides a cylindrical surface 45 terminating at its one end in a transverse shoulder 46. From the other end of surface 45 an inwardly ex-

tending taper 47 extends to the extremity of projection 44.

In the assembled condition of the joint the cylindrical surfaces 41 and 45 are in laterally aligned, spaced relation, and, similarly the transverse shoulders 42 and 46 are in longitudinally aligned spaced relation. The several surfaces define an annular groove in which is installed an O-ring 48 like the rings 32 and 33 and having also initially a round configuration. An O-ring is selected for use having an initial diameter larger than the width of its mounting groove, as defined by the distance between surfaces 41 and 45, which diameter may also exceed the spacing between the surfaces 42 and 46. In the assembly of the parts an uncompressed O-ring is placed on the tapered surface 47 on nose 44 or is dropped into the tapered formation 43 in member 35. Then the members 35 and 36 are aligned with one another and brought into telescoping relation, relative longitudinal motion continuing until limited by abutment of the flanges 37 and 38 with one another. Application of the clamp 39 then holds the parts detachably against disassembly.

During advance of nose 44 into the member 35, the O-ring is gripped between the tapered surfaces 43 and 47 and gradually compressed in a radial sense, a maximum degree of compression being reached and held as the cylindrical surfaces 41 and 45 achieve their aligned position in co-operative relation with the ring. In this position of the parts, therefore, the ring is under the radial compression and so makes a resilient sealing contact with the surfaces 41 and 45 inhibiting an escape of pressure fluid thereby. A back-up for the ring is provided by either one or both of the surfaces 42 and 46. In the illustrated instance the ring is subject to longitudinal compression between the surface 42 and 46 but such compression is unnecessary to an effective sealing of the surfaces 41 and 45.

The concept of radial sealing here expressed obviates the loss of a sealed joint as might result from relative bowing or separating motion of the members 35 and 36 due to excessive pressure and temperature differential effects. Thus if the surfaces 42 and 46 were the principal sealed surfaces a bowing or relative extending motion of the member 35, for example, draws the surface 42 away from the surface 46. The natural resilience of the sealing ring tends to compensate for this motion but under extreme conditions the separation of the sealed surfaces may exceed the permitted recovery of the sealing ring. The radial seal retains the advantages of the compressed O-ring without, however, having to cope with the problem of excessive deflection. The surfaces 41 and 45 obviously may be made long enough to keep the ring under compression against any possible extent of longitudinal separation of the parts 35 and 36. Relative lateral motion of the parts substantially is precluded by the interfitting character of the connection between the parts.

The embodiment of Figure 5 shows a radially sealed joint essentially the same as Figure 4. Rather than a connection between pipe ends, as in Figure 4, however, Figure 5 illustrates a joint between a closure 49 and a pipe end or container 50. Also, the parts are bolted rather than clamped together. The elements have respective flanges 51 and 52 held in abutting contacting relation by installed bolts 53. Closure 49 has a nose 54 received in member 50 and formed, like the nose 44 of Figure 4, with a taper surface 55, a cylindrical surface 56 and a transverse shoulder 57. Part 50, like part 35 of Figure 4, has interior taper, cylindrical and shoulder surfaces 58, 59 and 61. These co-operate with the surfaces 55—57, and with an O-ring 62, in the manner and to the same end as set out in connection with Figure 4, the interengagement of the parts making an effective radial seal which is securely maintained against excessive bowing or other stress tending longitudinally to separate the joined parts.

Figures 4 and 5 show the concept of radial sealing, which is a part also of the disclosure of Figure 1, applied to other installations of a kind in which compressible O-rings frequently are used.

WHAT WE CLAIM IS:—

1. A joint construction, including a pair of joint members brought to an assembled position by a relative axial approaching motion, one of said members being received within the other, means on said members defining an O-ring groove, a compressible O-ring in said groove, and means obtaining in response to a relative axial approaching motion of said members to assembled position first a radial compression of said O-ring and then a longitudinal compression thereof.

2. A joint construction according to Claim 1, characterised in that said last named means includes parallel cylindrical surfaces on said members defining the extent of radial compression of said O-ring and maintaining such compression constant as against limited relative longitudinal movement of said members.

3. A joint construction according to Claim 2, wherein that joint which is the inner member and is received within the other joint member, is formed with a frusto conical formation terminating in the cylindrical surface, the other said member having a cylindrical surface which in the assembled position of the joint is in spaced parallel relation to the cylindrical surface and wherein the normal diameter of the section of the compressible O-ring is greater than the spacing between said cylindrical surfaces, assembly of the joint producing a radial compression of said O-ring in the initial relative approach-

ing motion of said members, which compression is maintained at a constant value throughout limited relative longitudinal motion of said members.

4. A joint construction according to Claim 1 wherein the O-ring groove is in part defined by transverse abutment means on said members, portions of said groove between said abutment means being formed as opposing cylindrical surfaces, said O-ring being received between said cylindrical surfaces and having a normal diameter greater than the spacing therebetween, at least one of said members further having a taper formation responding to a relative axial approaching motion of said members radially to compress the O-ring, said O-ring being thrust longitudinally by said approaching motion between said cylindrical surfaces and seating between said abutment means for application of a longitudinal compression to the ring, the radial compression of said O-ring being constant as against relaxations in the applied longitudinal compression.

5. A joint construction according to Claim 1, characterised in that the O-ring groove is in part defined by lateral shoulders on respective joint members, there being two resilient sealing O-rings installed in said groove each seated on a respective one of said shoulders, and a floating connection between said sealing rings adapted to apply longitudinal compression thereto in response to relative adjustment of the joint members to cause the spaced shoulders to approach each other, one of said members further being formed with a frusto conical formation to achieve radial compression of the O-rings.

6. A joint construction according to Claim 5, wherein the joint members are formed respectively with external and internal frusto conical surfaces terminating in cylindrical surfaces in parallel, radially aligned relation, said cylindrical surfaces leading to the lateral shoulders.

7. A joint construction according to Claim 5 or 6 wherein the joint members have a threaded connection, one thereof having a conical portion adapted to be brought to mating contact with the flared terminal of an inserted pipe end by advance of said members into interfitting relation, and compressible O-ring seating on one of said members being in common sealing contact with the pipe end and with said one member, and wherein the floating connection has a portion bearing on the joints between the flared terminal of said pipe end and the conical formation of the said one joint member whereby to provide means to compensate for relaxation in the structural members of the joint.

8. A pipe joint or the like, according to any preceding claim wherein the resilient sealing O-ring comprises a compressible metal O-ring.

9. A pipe joint or the like, substantially as described hereinabove with reference to Figures 1, 2 and 3, 4 or 5.

For the Applicants:
CARPMAELS & RANSFORD,
24, Southampton Buildings, Chancery Lane,
London, W.C.2.

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